CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Weston D. Braun

Project Number

S0901

Project Title

Active Load Distribution for Increased Efficiency in Piezoelectric Converters

Abstract

Objectives/Goals

One of the greatest obstacles in the further minimization of electronic devices is the switch mode power supply (SMPS). The size of SMPSs is limited by the magnetic transformer they contain. One device that promises to eliminate this magnetic transformer is the piezoelectric transformer (PT). PTs are lighter weight, have a greater power density than ferrite core transformers and emit little electromagnetic interference. The implementation of PTs in SMPSs has been hindered by two main disadvantages: the fact that the efficiency of a PT is highly dependent on loading, and that there is no single unit PTs capable of matching the high power output of a magnetic transformer. This project attempts to tackle both these disadvantages by utilizing a parallel arrangement of piezoelectric transformers under microprocessor control. Through parallel operation, the maximum power output is increased, and through microprocessor control the loading on each PT is optimized for maximum efficiency.

Methods/Materials

Three PT drivers were designed and constructed to drive piezoelectric transformers that were modeled and optimized in Mathematica and etched from commercially available piezoelectric material. An Arduino development board was used to measure power output and control the state of each PT driver. The number of PTs being driven was determined in software based on the load resistance and the optimum load resistance of a single PT.

Results

The PT converter assembly was able to convert an 8 volt input to 18 volts and achieve a peak efficiency of 68.1%. A maximum power output of 5.48 watts was achieved. The microprocessor controlled assembly was able to output much greater power at a higher efficiency than that of a single PT.

Conclusions/Discussion

This project has demonstrated a feasible way of overcoming some of the major limitations of PTs and reliable control method for PTs was developed. With further research, PTs promise to allow for significantly smaller and lighter weight power supplies.

Summary Statement

An active control scheme was developed and tested to overcome some of the limitations of piezoelectric transformers through the use of a parallel configuration.

Help Received

Dr. Ian Galton was my project advisor and provided access to lab equipment at UCSD and also reviewed my electrical schematics.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Mitch S. Chau

Project Number
S0902

Project Title
Energy Harvesting: Micro Thermoelectric Generator

Abstract

Objectives/Goals
Heat generated by equipment such as car engine etc. is often wasted into the environment. This experiment was to capture wasted heat and converting it into electricity to power a light emitting diode (LED). A miniature thermoelectric generator was created based on Seebeck # Peltier effect. The hot and the cold junction temperatures and the measured terminal voltages are used to calculate the Seebeck coefficient to prove this experiment.

Methods/Materials
Utilizing a commercial Peltier module of size 1.5" x 1.5", heat sinks, and an integrated circuit, a miro-thermoelectric generator was created to capture heat and convert it into small electrical energy enough to light up a LED.
The idea is based on Seebeck-Peltier's equation V= A*(Th-Tc), where A is the Seebeck coefficient, Th is the hot side temperature, and Tc is the cold side temperature. Data was taken to verify the Seebeck Coefficient.

Results
1) The voltage potential produced by a Peltier module, when being subjected to a hot surface and cold surface, can be further boosted up by using an electronic multiplier circuit to produce a larger voltage
2) The thermoelectric generator can produce 9mW to 16mW depending on how well the system is coupled to the heat source to power a LED
3) In this experiment, the objects that were used to help light up the LED lights were a heater, and a blow dryer (hot and warm temperatures). The heat blower made enough voltage to turn the LED since it requires at least 3 V and 1mA # 3mA to operate.
4) An electronic multiplier is necessary to boost the voltage to about 5V

Conclusions/Discussion
1) Reading temperatures and voltages by eyes (human errors)
2) Challenge remains in separating the hot and cool side of the generator
3) will there be any other ways to hide the cool side better?
4) By parallel many of these units, more power can be produced

Summary Statement
Harvesting wasted heat energy into useful electrical energy to power small electronic devices.

Help Received
Help received from my Dad to wire the board and buy components. Dad also helps getting the multiplier to work. Use borrowed equipments from Uncle.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Alexander L. Chen

Project Number

S0903

Project Title

A Maximum Power Point Tracking Circuit with a New Hill Climbing Algorithm

Abstract

Objectives/Goals

The objective was to determine if a new and simple hill climbing (HC) maximum power point tracking (MPPT) circuit, developed in this project for optimizing the efficiency of the solar panel, could resolve well known deficiencies of popular MPPT circuits based on the conventional HC and perturb-and-observe (P&O) algorithms.

Methods/Materials

An HC MPPT circuit was designed, constructed, and tested. It consisted of a solar panel, a boost DC-DC converter, an LED load circuit, all home-built, and a microcontroller which hosted a new HC MPPT algorithm. In this algorithm, the microcontroller measured the solar panel output power at five switching duty cycle settings of the DC-DC converter for each perturbation cycle, and then dwelled at the duty cycle which resulted in the highest power. This optimal duty cycle was then used as the midpoint for the next set of perturbations. This process repeats over and over again to allow the solar panel to operate at its maximum power point.

Results

The MPPT circuit achieved >98% of electrical power that could be achieved by manually setting the switching duty cycle of the DC-DC converter to its optimal value. It showed fast and robust maximum power point tracking under rapidly changing irradiance conditions and was insensitive to voltage ripples caused by the switching circuit.

Conclusions/Discussion

The MPPT circuit of this project demonstrated fast, robust, and efficient maximum power point tracking capability with a new yet simple HC algorithm without resorting to complicated mathematics or logics.

Summary Statement

A maximum power point tracking circuit and a new hill climbing algorithm with fast and robust tracking capability was developed and demonstrated.

Help Received

Dr. Yaochung Chen provided guidance on circuit design and microcontroller programming. Mr. Peter Starodub provided guidance on project planning and progress tracking.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Taylor Fountain; Paige Wagar

Project Number
S0904

Project Title
Is Wave Energy a Sufficient Source of Electricity?

Abstract

Objectives/Goals
Our objective is to demonstrate how wave energy can be converted into electricity by using the vertical motion to pressurize air and light a light bulb.

Methods/Materials
We used a large trashcan, a laptop fan, and surgical tubing to construct a device to convert wave-generated air pressure into electricity. We tested the necessary PSI to light the lightbulb prior to testing our device in the ocean.

Results
We found that the light bulb was lighted one out of twenty times in experimentation, proving that our device was not a sufficient source of electricity, but had potential.

Conclusions/Discussion
One source of error during the process of our experiment could be that when we pulled the mechanism down, it wasn#t level and therefore not getting the full P.S.I. Another could be that outside forces such as wind or water could have affected the air stream from the hose and therefore the speed of the fan. Along the same lines, if the trash can was not properly sealed, we would lose potential P.S.I. From this experiment, we have learned the uses of not only wave energy but pressurized air. In our project we combined the two to potentially generate electricity, but separated, they could both be very useful sources of renewable energy, which is something that has been very popular in the past couple of years. To better our results, we will add one-way valves to allow air to return into the device. To continue our experiment, we could try a larger container that funnels into a more focused outlet at the top to pressurize the air even further to get a higher P.S.I. and therefore more volts of electricity.

Summary Statement
Our project is to create a simple device made of household items that can effectively convert wave power into electricity.

Help Received
father helped with construction and design

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Matt Hantke; John "Jack" Peterson

Project Number
S0905

Project Title
Which Types of Waves Will Create the Most Energy?

Abstract

Objectives/Goals
To extract usable energy from ocean waves and find out which types of waves will create more energy.

Methods/Materials
Wood, Plastic Sheeting, Copper Wire, Neodymium Magnets, Water, Voltmeter, Metal Rod, PVC Pipe, and Corks.

Results
Small quick waves produced more energy, peaking at 160.56 mV.

Conclusions/Discussion
We concluded that the small quick waves will produce more energy than the large slow ones in the ocean.

Summary Statement
Extracting usable energy from ocean waves.

Help Received
Parents drank the wine to supply us with corks..

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Sean W. Kelley

Project Number

S0906

Project Title

Measurement of Glucose in Aqueous Solution Using a Proton Magnetometer

Abstract

Objectives/Goals

My hypothesis is that if the glucose concentration is varied in an aqueous solution then by using a proton magnetometer, with a two coil relay system, the glucose concentration can be determined by measuring the frequency, amplitude, decay constant, and Q (inverse bandwidth) of the resonance

Methods/Materials

Two coils were created out of 18 gauge wires around a 5.8cm diameter and 7.8cm long around a PVC pipe. Each coil contains 600 turns of wire with a resistance of 4ohms and 21.34mH of inductance. A rely system was created to connect the coils to power and switch to a National Instruments measurement unit. The experiment began by activating a switch which connected the coils to power for approximately 2.4 seconds. Then the coil was then disconnected from power and reconnected to the measurement unit.

Results

A total of 9 trials were conducted; 7 were with glucose dissolved in 125ml of water from 0.79% to 7.5%, 1 was with only 125ml of water and 1 was with no solution. The one trial of water showed a singular resonance peak at 2006Hz, while the one trial without solution showed no resonance peak at all. The 7 trials with glucose showed that the concentration affected the amplitude, Q factor and decay constant of the peak resonance frequency.

Conclusions/Discussion

The experiment confirmed part of my hypothesis in that I measured a difference in the peak resonance amplitude but I measured no difference in the resonance frequency and thus disproved that part of my hypothesis. In addition, I also found that the concentration of glucose altered the Q factor and the decay constant. This study shows that it is physically possible to noninvasively measure glucose which has not been done before.

Summary Statement

My project is about using a proton magnetometer to measure the concentration of glucose dissolved in water.

Help Received

Father helped build proton magetometer, Mr. Joseph Geller provided designs for proton magnetometer

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Minjong Kim; William McGrath

Project Number
S0907

Project Title
A New Sustainable Energy: Microbial Fuel Cell

Abstract

Objectives/Goals
The United States produces approximately 236 million tons of waste annually. The purpose of this experiment is to build and test a microbial fuel cell (MFC). To prove that it is an alternative method for creating electricity and avoiding depleting our natural resources.

Methods/Materials
Three microbial fuel cells were built and tested using organic waste matter as fuel that converts chemical energy to electrical energy by the catalytic reaction of microorganisms. Five trials were conducted. Voltage output was tested twice a day, once in the morning and once in the late afternoon for a period of 30 days and 20 for trials 4 and 5 (because of the lack of time).

Results
Each trial showed a reoccurring pattern. In the morning our data points were each very low, but by the late afternoon our data rose in voltage, significantly, and then proceed to decrease late at night. By the 10th day each trial fuel cell reached its panicle voltage output. Trails 4 and 5 showed the highest level of voltage output.

Conclusions/Discussion
In conclusion our hypothesis was validated. The fuel cells did overall increase the voltage output simply through bacteria production. Fuel cells, even on a miniature level, do prove to supply and produce energy needed to power or even create safe drinking water. Once microbial fuel cells can be commercialized, they will revolutionize our power generating system as well as water cleaning system.

Summary Statement
We created a microbial fuel cell which uses bacteria to create electricity and water.

Help Received
Dr. Gallo from UCSD provided supplies and advice for the project; William McGrath's mother and sister helped to create the board; Acquired mud samples from Tijuana Estuary Visitor Center.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Neeka A. Mashouf

Project Number
S0908

Project Title
The Effect of Fresnel Lens Magnification on Solar Cell Energy Output, Cell Temperature, and LED Light Brightness

Abstract

Objectives/Goals
The objective was to determine if a type of solar concentrator, known as a Fresnel lens, could optimize the energy produced by a solar cell and it's energy application on an LED light, while keeping the consequential temperature endurable for the cell.

Methods/Materials
I tested 2x, 3x, and 4x magnifying lenses, as well as no magnification as a control on a solar cell by measuring the electric power produced (watts), cell temperature (F), and brightness of the LED light. To use the LED brightness as a qualitative measure of output power, I made a simple circuit that included the solar cell, 3 resistors, and the LED. The power data was calculated by multiplying the appropriate voltage and current values read by a voltmeter and an ammeter to measure the watts produced. Cell temperature was measured with an accurate laser-sight temperature gun aimed 2 inches away from the center of the cell.

Results
I hypothesized that the 3x lens would produce the optimal energy output and temperature, as well as yield the brightest light. My data supported this by showing that the 3x lens provided the highest power production of .495w (four times the control!) and brightest light at a tolerable temperature of 171.5 degrees Fahrenheit.

Conclusions/Discussion
My experiment proves that by using the right magnification of Fresnel lenses, energy production can be amplified and light can be focused on a smaller active cell area, making solar technology more cost-effective and productive.

Summary Statement
My project tests the effect of Fresnel lens magnification on a solar cell's energy production and consequent temperature from light concentration in order to find an optimum point between high power production and tolerable cell temperature

Help Received
Father taught me electrical circuit basics for breadboard construction; teachers answered all questions I had and provided guidance

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Danica K. Moeller

Project Number
S0909

Project Title
Which Motor Works Best?

Abstract

Objectives/Goals
The goal of my project is to build eight "Simple Electric Motors", and from that point to test the amount of voltage that each motor requires.

Methods/Materials
For this project the supplies needed are: a measuring tape, C-size battery, knife, magnet wire (enamel-coated, 22-gauge, approximately 75 feet), wood, wire cutters, thick copper wire (2, 6 inches long), 2 beads, battery holder (fits 4 AA batteries), 4 AA batteries, flip switch, 2 magnets, electrical wire, 4 LED lights (2 red, 2 green), sander, solder, solder iron, 2 pieces of nylon, 7 screws, drill, voltmeter, timer, and a notebook. Using these supplies, I built the motor by connecting the wiring underneath, and then setting up my display on the top. Once this was done, I could turn the motor on and test the voltage with a voltmeter.

Results
For the average voltage used I found that the 5 Winding motor used an average of 5.724 V, the 10 Winding motor used an average of 4.056 V, the 15 Winding motor used an average of 4.456 V, the 20 Winding motor used an average of 3.324 V, the 25 Winding motor used an average of 2.484 V, the 30 Winding motor used an average of 2.688 V, the 40 winding motor used an average of 2.556 V, and the 50 Winding motor used an average of 3.248 V. As a result, the 5 Winding motor required the least amount of voltage, and the 25 Winding motor required the most amount of voltage.

Conclusions/Discussion
In the end, the 5 Winding motor required the least amount of voltage. I believe that this is because it used the least amount of wire since it was wound less, and since it used less wire, there was less space for the volts to flow. I also found that the 25 Winding motor required the most voltage, rather than the 50 Winding motor. I believe that this could either be an experimental error, or because it is not too big, yet not to small, so it used the most amount of voltage. I found, however, that the bigger a motor is, the more voltage it uses, and the faster it spins. So this means, the bigger the motor, the more power it has. A few experimental errors that I could have had would be that the batteries ran out of juice often, the LED lights took away some of the power, and the Windings weren't tightly coiled enough.

Summary Statement
The purpose of this project is to build eight motors, and to then test which motor, big or small, requires the highest amount of energy, or voltage.

Help Received
Mother bought me the batteries; Father helped gather supplies for building; Father showed me how to wire the board and connect everything

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Ryan Y. Nguyen

Project Number
S0910

Project Title
The Effect of a Step Down DC-DC Converter on Supercapacitor Voltage Output Time

Abstract

Objectives/Goals
My experiment's objective is to determine if a step down DC- DC converter can extend the useful time power can be extracted from supercapacitors. First, I established a baseline discharge time with and without a step down DC-DC converter. Then, I varied the charging voltage and output load. It was expected that adding a converter would increase the discharge time and that the discharge time would vary proportionally with the charging voltage and load.

Methods/Materials
The test hardware consisted of a set of eight supercapacitors, a step down DC-DC converter, and two LED loads which were constructed from off the shelf components. Support equipment consisted of a power supply and two digital multimeters. The capacitor voltage into the converter and output voltage into the load were measured every five minutes until the capacitors were discharged.

Results
The data shows the LEDs remained lit significantly longer when the converter was present. The next step doubled the LED load from 5 to 10 LEDs, and I retook the measurements. Interestingly, the discharge time did not decrease proportionally as expected. I expected the discharge time to decrease by 50%, but the data only shows a decrease of approximately 20%.

Conclusions/Discussion
The unexpected 20% drop in discharge time when the number of LEDs was doubled should be explored further. This could be caused by several factors, such as nonlinear converter effects or visual perception of the red LED's brightness. Regardless of cause, this observation can potentially be exploited to improve energy efficiency.

Summary Statement
My experiment's objective is to determine if a step down DC- DC converter can extend the useful time power can be extracted from supercapacitors

Help Received
Used lab equipment and received technical assistance at Buu Nguyen's (Father) company Sigma Test Labs.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
David J. Nolan

Project Number
S0911

Project Title
Polarized Power: The Study of a Rectenna Designed to Generate Electricity from a Common Television Signal

Abstract

Objectives/Goals
If a rectenna could be constructed to turn common television frequency signals into direct current then this type of unused energy could be a potential source of electricity.

Methods/Materials
The Antenna- The 1/2 inch copper pipe is cut into two, 9 and 3/4 inch pieces to be optimized for the entire UHF spectrum. Both pipe sections are inserted into the plastic junction box, forming a "T". The coaxial TV cable was cut to expose the internal copper conductor in the wire. A secondary cut was used to extract the metal grounding insulation.The copper conductor was soldered to one of the copper pipes and the metal grounding insulation was soldered to the other. The coaxial TV cable was inserted into a 5 and ½ foot piece of PVC pipe, to provide a stable handle for the Dipole antenna.
The Rectifier- A plastic wafer circuit board was wired into a rectifier using capacitors and diodes. The rectifying components were then wired to the ground. The circuit input wire was soldered to the copper output wire of the dipole antenna.
Optimizing the antenna- After selecting the strongest UHF television signal available (frequency 854-860 MHz), the antenna was optimized by cutting 3 inches off of each side. This optimization was based on the dipole formula that length in inches is equal to 498 divided by the frequency in MHz.
The Rectenna- With the antenna wired to the rectifier, the device is now a functioning rectenna. The output of the rectenna was measured using a voltmeter.
Charging a Battery- A DC battery charger was taken apart and it was wired to the rectenna's output. The device was monitored every two hours and the battery charge was checked with a battery tester.

Results
After 140 collective trials, a UHF television frequency of 854-860 MHz was used to generate 0.1 volts of electricity. The electricity from the rectenna was used to charge a 1.5 volts rechargeable battery over a 12 hour time period.

Conclusions/Discussion
Rectennas were designed to transform microwaves into direct current electricity. Since microwaves are just one form of RF energy rectennas may be able to generate electricity from other forms of RF energy. This experiment successfully demonstrated that a rectenna could be constructed to turn common television frequency signals into direct current.

Summary Statement
The study of a Rectenna designed to generate electricity from a common televison signal.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Dalia S. Rahmon

Project Number
S0912

Project Title
Cell Phones: Friend or Foe?

Abstract

Objectives/Goals
The objective of my project was to determine how and if levels of radiation emitted by cellphones varied when the phone was recieving a call and a text message. I also tested how the levels of radiation detected varied using different brands and ages of the cellphones, while the phones were placed at different distances from the microwave leakage meter.

Methods/Materials
(1)Microwave Leakage Meter (Measured in mw/cm^2)
(2)Metric Ruler
(3)10 Cell Phones (Varying in age, brand and carrier)

Results
The average amount of radiation emitted from receiving a call was about double the amount detected when the test phone received a text message.The average amount of radiation emitting (mw/cm^2) from sending a text message to the test phone at 0cm was .126, at 5cm was .0476, and at 10cm was .015. The average amount of radiation emitting (mw/cm^2) from receiving a call at 0cm was .358, at 5cm was .086, and at 10cm was .0293.

Conclusions/Discussion
The purpose of this experiment was to test the amount of radiation emitted by cell phones, and if this number was influenced when either calling or sending a text message to the cell phone being examined. The control for this project was the distance between the cell phone and the microwave leakage meter(0cm, 5cm, 10cm). The dependent variable was the amount of radiation detected from the cell phone. My hypothesis was that more radiation would be emitted when a phone received a call rather than a text message. This was proven true through several trials. More radiation was detected when a cell phone received a call, and a significant difference in radiation was detected as the phone was placed closer to the microwave leakage meter. I found that the brand and age of the test phones did influence the results. However, there were no trends in the outcomes of various carriers of the cell phones tested. A possible error may have been testing this radiation in an open room, where the radiation could have easily dispersed. Also, by performing my experiment in a room containing other electronics, the leakage meter may have detected radiation from surrounding devices along with the phones being tested.

Summary Statement
To test the amount of radiation emitted by various cell phones at different distances between the phone and microwave leakage meter when both sending a call and a text message to the phone being tested.

Help Received
Friends and family members supplied cell phones to test for the experiment.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
George P.C. Randel

Project Number
S0913

Project Title
Five Channel Open Source Multimeter

Abstract

Objectives/Goals
Often, when working with electronics, one needs more than one multimeter. Which takes up more space on the bench, can be expensive , and requires one to have more back up batteries. The four Channel open source multimeter solves this. The four channel multimeter includes two current channels, two voltage channels, and one LCR channel. This allows one meter to do things like measure efficacy in real time.

Summary Statement
This project shows process I am currently going through to design a 5 channel open source multimeter.

Help Received
My Mother help layout display, Professor at CSUN proofread my report.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Alexander E. Ross

Project Number
S0914

Project Title
Backyard Hydroelectric Generation

Abstract

Objectives/Goals
The objective of my project was to generate electricity from a motor utilizing water and the force of gravity.

Methods/Materials
A ten foot tall wooden derrick was constructed to hold a tank with the capacity to hold 135 gallons of water on top. A system of electrical wiring between a solar panel, car battery, and submersible water pump power the pump to pump water from a reservoir tank to the tank on top of the derrick. A PVC pipe system controls the flow of water up to the tank as well as the drainage from the tank to a Pelton wheel assembly within the derrick roughly one foot above the initial platform. The water drains from the tank and spins a Pelton wheel that, through a system of drive wheels and axels, powers a DC motor. From there, the water drains back into the reservoir tank and the cycle repeats itself as the water is pumped back up to the suspended tank. The water flow down to the Pelton wheel assembly is controlled by a ball valve that is used to disrupt the flow of the water and "turn off" the generator.

Results
The 12 volt motor I used had an electrical output consistent with about 2.5-2.8 volts of DC electrical current and had a consistent DC amperage of .01 mA.

Conclusions/Discussion
My results reveal that the generator did not generate a very substantial amount of energy. However, the project did reveal that the design was a success being that it did show that if the concept is executed it is feasible to generate electricity. Though the design I have created does have flaws I believe that if it can be perfected the possible outputs of this generator could increase greatly from the results in this experiment.

Summary Statement
In my project I utilized the powers of water and gravity to construct a functional hydroelectric generator

Help Received
Grandfather helped with construction and blueprinting

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Shayan Sadigh

Project Number
S0915

Project Title
Optimal Levitation Height Based on the Placement of a Neodymium Magnet on a YBCO Superconductor

Abstract

Objectives/Goals
The purpose of this research project was to determine if placing a neodymium magnet (Nd2Fe14B) on a certain location, or quadrant of a Yttrium barium copper oxide superconductor would result in the very differential yielded heights of levitation while levitating using the Meissner Effect of Superconductivity.

Methods/Materials
To obtain the magnet and superconductor, a Colorado Superconductor Inc. Kit was used. Four quadrants were drawn onto the superconductor and the center of it was marked also. An apparatus consisting of an area for the superconductor and liquid nitrogen to be placed for the initial levitation was designed and created from a simple Styrofoam box and a bowl, the bowl had a hole in the side that allowed a green laser that was attached to the box pass its beam through and take advantage of the liquid nitrogen vapor, resulting in a illuminating green beam. This allowed one to simply take pictures of each conducted trial and then use ImageJ # an image analysis program from the National Institutes of Health, to calibrate the pixel to millimeter ratio and find accurate and precise data. Images were taken from an angle, and from the top (to validate the levitation). Using ImageJ the levitation Height of each magnet can be found by subtracting the distance from superconductor to the bottom of the laser beam by the mean of the distance of the magnet from the beam. The following equation was formed: Levitation height = D # B(m).

Results
Every trial conducted made it blatantly obvious to the naked eye that quadrant three of the superconductor demonstrated the lowest levitation heights 100% of the time. There was no trial were any quadrant levitated lower than quadrant three. There was an average deviation of 1.5, and the percent deviation was 14.2%, due to the fact that quadrant three and the center had such a large difference. In reality the deviation would be much lower; however each trial received a deviation, not each quadrant because it would be very difficult to calculate with a square shape magnet.

Conclusions/Discussion
The center levitated the highest 100% of the time, this ongoing trend suggests that the closer the magnet is placed towards the center, the greater the levitation height. This is perhaps due to the fact that the center has the greatest amount of excluded fields, and thus the greatest levitation heights.

Summary Statement
Finding the best placement on a superconductor for the highest levitation height.

Help Received
Professor Debra Mauzy-Melitz provided a lab at UCI to work in

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Amit S. Talreja

Project Number
S0916

Project Title
Robot Assisted Pattern Recognition and Analysis

Abstract

Objectives/Goals
The goal of this project is to design and develop a robot that can teach a child to write basic letters and numbers. The machine can assess the child's writing and give feedback on it's accuracy. The robot should identify characters with a high degree of accuracy.
The robot is a platform for children to learn writing at their own pace with minimal human interaction. Though targeted at children with Autism it should be a fun way of learning for all.

Methods/Materials
The Lego Mindstorms NXT microcontroller and several sensors and gears are used to create a robot that is able to write and scan characters.
The software program written in RobotC operates the machine to write the control character and then scan the user input and compare it against the control. The Robot hardware and software was tested and modified to improve accuracy.

Results
For the project, the accuracy of four characters (E, F, 4 and 7) was tested.
The letters E and F had an accuracy of 90 and 80 percent respectively, while the numbers 4 and 7 had an accuracy of seventy percent each.

Conclusions/Discussion
The project was mostly successful in achieving it#s goals. The robot was able to recognize characters with approximately 80% accuracy. The robot struggled with diagonal lines, it is hypothesized that this is due to the scanning method used.
Based on testing several improvements were made during the course of the design. For example, the redesign of the writing arm and pen mechanism to get just the right pressure, change of the gear types and ratios to balance torque and tolerance. The software was modified significantly from the start to improve scanning accuracy and resolution.

Summary Statement
The objective of the project is to design a robot that can help children with autism learn to write letters and numbers.

Help Received
Received feedback from occupational therapists working with children with autism on how to improve the robot.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
William J. Theaker

Project Number
S0917

Project Title
Can Temperature Affect the Self-Discharge Rate of Primary and Secondary Cell Batteries?

Abstract

Objectives/Goals
This project investigated the effects of cooling batteries to slow their self-discharge rate. All batteries suffer from self-discharge, or loss of stored charge in a battery even when not in use. Because high temperatures speed up internal chemical reactions and colder temperatures slow them down, the hypothesis was that batteries exposed to colder temperatures would retain more charge than batteries kept at room temperature. The results of this experiment would be beneficial because it indicates less primary cells batteries need to end up in landfills, and less energy would be needed to keep recharging secondary cells.

Methods/Materials
To perform the experiment, 60 batteries were purchased: 30 primary cells, which included 15 Alkaline and 15 Lithium batteries; and 30 secondary cells, 15 NiMH (nickel-metal hydride), and 15 NiCd (nickel-cadmium) batteries. The volts of the batteries were tested using a multimeter and recorded. Next, five of each type of battery were placed in plastic bags, then in three different environments: room temperature, a refrigerator, and a freezer. The batteries were taken out at weekly intervals and the voltage was measured over a four-week period.

Results
At room temperature the NiMH batteries lost an average of .1162 volts, in the refrigerator .0548 volts, and in the freezer .0386 volts. The NiCds lost an average .0654 volts at room temperature, .0288 volts in the refrigerator, and .0102 volts in the freezer. At room temperature the Lithium batteries lost an average .0006 volts, .0106 volts in the refrigerator, and in the freezer an average .0088. The alkaline lost an average .0024 volts at room temperature, in the refrigerator .0002 volts, and in the freezer 0 volts were lost.

Conclusions/Discussion
The results showed that secondary cells retained 15%-17% more of their charge when placed in the freezer over room temperature. The primary cells did not need the refrigeration, because of their low discharge rate, and there was an actual loss of charge by the lithium batteries when put in the colder environments. This project proved my hypothesis to be correct -- since the secondary cells have a high self-discharge rate they should be placed in colder environments for maximum charge retention, but primary cells, because of their low self-discharge rate, should not be put in these lower temperatures.

Summary Statement
This project investigated the effects of cooling batteries to slow their self-discharge rate.

Help Received
Dr. Kirt Williams helped with multimeter selection and measurement.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Yu J. Tung

Project Number
S0918

Project Title
Energy Efficiency in the Energy Generation from an Inductive Coil Mechanism in Different Applications of a Moving Ball

Abstract

Objectives/Goals
If the inductive coil mechanism is placed inside a basketball with its heavier side(the surface of the basketball that's heavier than the rest) on top of either pole of the magnet, the ball will always bounce in the direction that will fully move the magnet up and down, thus producing electricity every time kinetic energy is input into it. For a soccer ball, the ball has to be kicked in a certain direction for the inductive coil mechanism to generate energy.
The objective of this project is to determine whether the energy generation from an inductive coil mechanism will be greater inside a basketball or inside a soccer ball.

Methods/Materials
Building Materials are Bouncy Putty, cardboard, toilet paper roll, wires, double-sided tape, zip lock bag, concrete mix, Velcro tape, and superglue. The testing material I used is a piezoelectric disc.

Methods: I built a bouncy ball made of Bouncy Putty. I cut the bouncy ball in half, put my inductive coil mechanism inside, and then hold the two half with Velcro tape. I bounced the ball ten times on a piezoelectric disc and then calculated the amount of energy generated by the inductive mechanism per an amount of forces applied each time through the voltages generated by the piezoelectric disc(which is proportional to the force applied on the disc). I did that same procedure, but instead of bouncing it, I kicked it.

Results
Inductive coil mechanism inside a soccer ball will generate more electricity than when it is inside a basketball. In fact, it is around 5.6 times more efficient in energy generation inside a soccer ball than if it is used inside a basketball, which can be seen through my data.

Conclusions/Discussion
Reason for the significant differences in the generation of energy of an inductive coil mechanism inside a basketball and a soccer ball could be the fact that when the ball is kicked, it rolls in a circular manner. And when it does, it fully moves the magnet from one end to another, thus maximizing the energy generation. Wherein a basketball, even if the same surface were hit every time, the magnet might not bounce high enough inside the coil for maximized energy generation.

Summary Statement
To determine whether an inductive coil mechanism inside a pre-made basketball in which eveytime it is bounced, same surface will land, will generate more energy than if the inductive coil mechanism is inside a soccer ball.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Daniel S. Yang

Project Number

S0919

Project Title

The Effect of Path Distance on the Loss of Signal Power between Receiver at Ground Level and Transmitter at Fixed Height

Abstract

Objectives/Goals

The objective of this project is to address the question: what is the effect of distance between a transmitter and a receiver on the propagation loss of signal power? Unlike other studies of its kind, this study was novel in that it emphasized on the propagation loss when the receiver was strictly at the ground level while the transmitter was at a fixed height above ground.

Methods/Materials

Received power in dBm was measured as a function of distance from the base of the transmitter to the receiver. The router was turned on and the receiver unit was placed at the first distance of 4 meters. After 60 seconds, the average power of the received signal for that time frame was generated by the spectrum analyzer software and then recorded. This process was repeated in 4-meter increments to 44 meters. 3 trials were conducted, and a total of 33 data points were collected. For transmitter, a Linksys home wireless router mounted on a vertical wooden plank at a height of 228 cm was used. For receiver, a laptop computer, a wireless USB device, and a spectrum analyzer software were used to measure the received power.

Results

Regression analysis showed a general trend of decreasing power represented by the equation: (Received Power in dBm) = -0.5409 (Distance) - 71.594; R-squared was 0.9396. The Log-Distance Model was used with another regression analysis to calculate the experimental n=1.999 with R-squared=0.7635. Removing anomalous data at four meters produced an experimental n=2.956 with R-squared increased to 0.9407.

Conclusions/Discussion

The t-Test results supported the hypothesis that the loss of signal power increases when path distance increases. More detailed regression analysis using Log-Distance Model showed that experimental n=2.956 was less than Two-Ray Model's n=4; because this study eliminates the reflected ray, it should minimize interference between direct ray and reflected ray and produce an n that is less than 4. The same experimental n=2.956 was more than Free-Space Model's n=2; this made sense because in terrestrial setting, propagation loss could not be better than that in free space. This study was novel in that it was the one that examined the boundary case of the Two-Ray Model where the receiver is at the ground level and the reflected ray is eliminated. The results could help in designing radio links to control machines or sensors that have antennas that are at or near the ground level.

Summary Statement

This project collected field data on received power as a function of distance and utilized path loss models to examine the propagation effects when the receiver is at the ground level.

Help Received

My teacher gave feedback throughout the project and my parents helped me on the background research and use of hardware and software.